FINAL

Douglass and Jones Runs Watershed TMDL
Clarion County

For Acid Mine Drainage Affected Segments

Prepared by the Pennsylvania Department of Environmental Protection

February 21, 2003

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[1]FINAL TMDL
Douglass and Jones Runs Watershed
Clarion County, PA

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for stream segments in the Douglass and Jones Runs Watershed (Attachment A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers two segments on this list and five additional segments (shown in Table 1). High levels of metals, and in some areas depressed pH, caused these impairments. All impairments resulted from drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum), and pH.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 17-B								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	4.5	5390	49719	Douglass Run	CWF	305(b) report	RE	Metals
1998	5.35	5390	49719	Douglass Run	CWF	SWMP	AMD	Metals
2000	3.23	5390	49719	Douglass Run	CWF	SWMP	AMD	Metals
2002	5.3	5390	49719	Douglass Run	CWF	SWMP	AMD	Metals
1996	Not currently on the 303(d) List			UNT Douglass Run				
1998	Not currently on the 303(d) List			UNT Douglass Run				
2000	0.44	5390	49724	UNT Douglass Run	CWF	SWMP	AMD	Metals
2002	Not currently on the 303(d) List			UNT Douglass Run				
1996	Not currently on the 303(d) List			UNT Douglass Run				
1998	Not currently on the 303(d) List			UNT Douglass Run				
2000	0.85	5390	49725	UNT Douglass	CWF	SWMP	AMD	Metals

[1] Pennsylvania's 1996 and 1998 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 2000 Section 303(d) list was not required by U.S. Environmental Protection Agency. The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of American Littoral Society and Public Interest Group of Pennsylvania v. EPA.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 17-B								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
				Run				
2002	Not currently on the 303(d) List			UNT Douglass Run				
1996	Not currently on the 303(d) List			UNT Douglass Run				
1998	Not currently on the 303(d) List			UNT Douglass Run				
2000	0.83	5390	49726	UNT Douglass Run	CWF	SWMP	AMD	Metals
2002	Not currently on the 303(d) List			UNT Douglass Run				
1996	2 1.5	5391	49720	Jones Run	CWF	305(B) Report	RE	Metals &pH
1998	4.01	5391	49720	Jones Run	CWF	SWMP	AMD	Metals & pH
2000	2.55	5391	49720	Jones Run	CWF	SWMP	AMD	Metals & pH
2002	4.0	5391	49720	Jones Run	CWF	SWMP	AMD	Metals & pH
1996	Not currently on the 303(d) List			UNT Jones Run				
1998	Not currently on the 303(d) List			UNT Jones Run				
2000	0.96	5391	49722	UNT Jones Run	CWF	SWMP	AMD	Metals & pH
2002	Not currently on the 303(d) List			UNT Jones Run				
1996	Not currently on the 303(d) List			UNT Jones Run				
1998	Not currently on the 303(d) List			UNT Jones Run				
2000	0.51	5391	49723	UNT Jones Run	CWF	SWMP	AMD	Metals & pHJ
2002	Not currently on the 303(d) List			UNT Jones Run				

Resource Extraction = RE
Cold Water Fishes=CWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Appendix E, *Excerpts Justifying Changes Between the 1996, 1998, and Draft 2000 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93
The 2002 303(d) list is, at this time, in Draft form and has not been finalized.

Location of the Douglass and Jones Runs Watershed

Douglass Run is located in Clarion Township, Clarion County and can be found on the 7½-minute Corsica and Strattanville USGS quadrangles. The headwaters of Douglass Run lie within the central-western edge of the Corsica quadrangle. The stream flows westward into the Strattanville quadrangle. The headwater area of Douglass Run can be accessed from Exit 70 (old Exit 11) of Interstate 80. Take State Route 322 east for approximately 0.3 miles, then turn left (north) onto Old State Road for approximately 0.6 miles, at which point it intersects with Asbury Road. Turn left (west) onto Asbury Road and travel approximately 0.1 mile to the first stream culvert crossing. This hollow is the headwaters of Douglass Run. Continuing on Asbury Road for approximately 1.3 miles will take you to the middle section of Douglass Run located approximately 3,400 feet upstream of the confluence with Jones Run.

Jones Run is also located in Clarion Township, Clarion County and is found on the 7½ minute Strattanville quadrangle. Jones Run can be accessed from Exit 70 (old Exit 11) of Interstate 80. Take State Route 322 west for approximately 2.5 miles. Turn right (north) onto Asbury Road for approximately 0.6 mile. Turn left (west) onto Miller Road and the first stream culvert crossing encountered is the headwater area of Jones Run.

Segments addressed in this TMDL

All of the permanent and problematic discharges in the watershed are from abandoned mines and will be treated as non-point sources. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. Where there is no responsible party the discharge is considered to be a non-point source. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Appendix D for TMDL calculations.

Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be "fishable" and "swimmable."

Additionally, the federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to USEPA every two years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and

- USEPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and USEPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against the USEPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While USEPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require USEPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.). These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific water bodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d)[2] list. With guidance from the USEPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (Pa. DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b) reporting process. Pa. DEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macro invertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macro invertebrates are identified to the family level in the field.

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[2] Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If two pollutants impair a stream segment, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculate TMDL for the water body using USEPA approved methods and/or computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

This document will present the information used to develop the Douglass and Jones Runs Watershed TMDLs.

Watershed History

There are no active mining operations within these watersheds. None of the companies that mined within these watersheds are actively pumping and/or treating water. All the discharges are from abandoned mining operations and will be treated as non-point sources. Many of the areas of mining are pre-Act with no historical information available to identify the mine operator. Other mining companies later reaffected several of these pre-Act areas within Jones Run watershed. The known mining history of the two watersheds include the following:

<u>Douglass Run</u>

The hilltop within the headwater area, north of Interstate 80, within the Corsica quadrangle is an area of pre-Act mining. No historical records exist to identify the company. The hilltop above and west of the stream crossing to the lower reaches of Douglass Run were also pre-Act mined and no data exists for this.

In 1986 R.E.M. Coal Co., Inc. submitted an application that was subsequently denied on October 7, 1986. This proposed site was located approximately one mile east of Interstate 80 (Exit 70). The site was located between Interstate 80 and Route 322. The mine drainage permit application number was 16860107 and was known as the Fleming Mine. Mining was proposed for the Lower and Middle Kittanning coal seams. Only the far western portion of the site would have drained to an unnamed tributary to Douglass Run. The majority of the application area was pre-Act mined, including the area that would have drained to the unnamed tributary to Douglass Run. Information contained in the R.E.M. application identified the surface mining as Carrior Coal Company, permit unknown. One seep from the Lower Kittanning spoil was identified as D1 on R.E.M.'s exhibit map. The seep was sampled on October 4, 1994, and had the following water quality: pH 4.3, 0 alkalinity, 40.4 mg/l acidity, 0.55 mg/l iron, 8.4 mg/l manganese, and 372 mg/l sulfate. R.E.M. also identified several Lower Kittanning drift mine openings, operator unknown. Given the low cover, these workings are probably very limited in extent and were likely developed for house coal.

In 1982 Strishock Coal Company submitted an application just northwest of the village of Day, along State Route 322 (Strattanville quadrangle). This application was eventually withdrawn. The mine drainage permit application was 16820118 and was known as the Servey Mine. Discharge from this site would have been to unnamed tributaries to Douglass and Jones Runs.

The western hill downstream on Douglass Run, between Mill Creek and the confluence with Jones Run, was mined by Mauersburg Coal Company, Permit No. 3675SM27 (Terwilliger Mine). No information from this permit is available.

<u>Jones Run</u>

The Jones Run watershed has been more extensively mined than Douglass Run. No data exists for the area of pre-Act mining; however, the more recent known permits include the following:

The mining on the previously mentioned Mauersburg Coal Company, Permit No. 3675SM27, also extended into the Jones Run watershed. Contiguous to the west and southwest of this Mauersburg permit was W. P. Stahlman Coal Co., Inc., Permit No. 3676SM21, referred to as Mine No. 112. The portion of this permit within the Jones Run watershed has been released. Only the far northwestern corner, which drains to an unnamed tributary to Mill Creek, was repermitted and remains under bond. This remaining portion of the permit has noncompliant discharges that are being actively treated.

The area directly south and contiguous to the W. P. Stahlman site was mined by Glacial Minerals, Inc., Permit No. 3677SM20. The coal seams listed for the site include the Brookville, Lower Clarion, and Upper Clarion. No records remain for this permit.

Directly west of the W. P. Stahlman and Glacial sites is H & G Coal & Clay Co., Inc. The original mine drainage permit number was 3677SM22. In the early 1980s this site was updated, changing the permit number to 16800111. Later, during primacy, a portion of the site remained and repermitted as 16803011. The portion of the permit that drained to Jones Run and unnamed tributaries was covered by Mine Drainage Permit Nos. 3677SM22 and 16800111. Bonds for this area have been released. The part that was repermitted (16803011) drains to an unnamed tributary to Mill Creek. This is the same tributary that W. P. Stahlman Permit No. 3676SM21 discharge drains to. There are post-mining discharges associated with the repermitted portion of the H & G permit that are being treated.

The hilltop west of the H & G site, which was pre-Act mined, was permitted by Zacherl Coal Company under Permit No. 3674SM14. This was known as the Zacherl No. 29 Mine. The Clarion and Lower Kittanning coal seams were identified to be mined. No records for this permit remain.

In 1980 W. P. Stahlman submitted an application for the area contiguous to the south of the H & G repermitted site of Permit No. 16800111. This mine drainage permit submitted by W. P. Stahlman was Permit No. 16800117. Both the Lower and Upper Clarion coal seams were requested for mining. On April 24, 1981, this application was denied for failure to demonstrate no presumptive evidence of pollution. W. P. Stahlman appealed the denial but later withdrew the appeal request on June 3, 1983.

Gas/Oil Well Development

Oil well development in Clarion Township goes back into the mid-1870s. The Clarion Oil Pool and smaller gas pools were found in various parts of the township. Jones and Douglass Runs lie within the eastern end of the township and are at the fringe of the Clarion Oil Pool. The numerous gas wells have been drilled throughout the 1900s. Records do not exist to identify the number or locations of these abandoned wells. Past mining has likely encountered some wells. Given the mining regulations in the early part of the 1900's, it is unlikely that these wells were sealed prior to whatever reclamation took place. To date, some of these abandoned wells are artesian thus creating discharges that have impacted the receiving streams. There is one discharging well along the west side of Douglass Run approximately 300 feet below the confluence of Jones and Douglass Runs. A second discharging well is located approximately 4,000 feet upstream, on Douglass Run, near the culvert crossing with Asbury Road.

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because of the nature of the pollution sources in the watershed, the TMDL's component makeup will be load allocations (LAs) that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that the water quality standards must be met 99% of the time. The iron TMDLs are expressed as total recoverable as the iron data used for this analysis was reported as total recoverable. Table 2 shows the water quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	Criterion Value (Mg/l)	Total Recoverable/Dissolved
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50 0.3	30-day average, Total Recoverable Dissolved
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Elements (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to nonpoint sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

TMDL Allocations Summary

Analyses of data for metals for points JR1, DR1 and DR2 indicated that there was no single critical flow condition for pollutant sources, and further, that there was no significant correlation between source flows and pollutant concentrations (Table 3).

Table 3. Correlation Between Metals and Flow for Selected Points

Point Identification	*Flow vs.*			*Number of Samples*
	Iron	*Manganese*	*Aluminum*	
JR1	0.146	0.259	0.0*	40
DR1	0.153	0.0*	0.0*	15
DR2	0.333	0.0*	0.0*	14

*there were not enough sample values collected for these metals to allow an accurate correlation

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. Table 4 presents the estimated reductions identified for all points in the watershed. Attachment D gives detailed TMDLs by segment analysis for each allocation point.

Table 4. Summary Table–Douglass and Jones Run Watershed

Station	Parameter	Measured Sample Data		Allowable		% Reduction	
		Conc (mg/l)	Load (lbs/day)	LTA Conc (mg/l)	Load (lbs/day)		
DR1	In-stream monitoring point						
	Al	1.41	73.2	0.11	5.9	92	
	Fe	5.53	286.50	0.44	22.90	92	
	Mn	2.83	146.70	0.14	7.30	95	
	Acidity	89.79	4650.50	0.00	0.00	100	
	Alkalinity	0.67	34.50				
JR1	In-stream monitoring point						
	Al	0.64	18.20	0.06	1.80	90	
	Fe	40.79	1155.00	0.41	11.60	99	
	Mn	18.18	514.70	0.36	10.30	98	
	Acidity	234.33	6635.70	0.00	0.00	100	
	Alkalinity	0.98	27.60				
DR2	In-stream monitoring point						
	Al	6.78	542.8	0.54	43.4	92	
	Fe	20.27	1624.0	0.41	32.5	98	
	Mn	16.55	1325.9	0.66	53.0	96	
	Acidity	160.89	12889.1	0.00	0.0	100	
	Alkalinity	0.00	0.0				

Recommendations

Two primary programs that provide reasonable assurance for maintenance and improvement of water quality in the watershed are in effect. The PADEP's efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by PADEP's Bureau of Abandoned Mine Reclamation, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania, the United States Office of Surface Mining, the National Mine Land Reclamation Center, the National Environmental Training Laboratory, and many other agencies and individuals. Funding from EPA's 319 Grant program, and Pennsylvania's Growing Greener program have been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

The PA DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; and administers a loan program for bonding anthracite underground mines and for mine subsidence. Administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

Remediation projects within Douglass and Jones Runs have been initiated by the Mill Creek Coalition, which is the local environmental group of the area. Their remediation work, so far, has been within Jones Run. The work within Jones Run is outlined in their February 13, 2002 meeting notes, as follows:

"Jones Run – Bernie Spozio reported that the second phase of the liming project being conducted on the Terwilliger portion of Gamelands 74 will be completely finished by the end of February. In total, 4,000 tons of lime was spread over about 180 acres. Bernie also reported that Norm Weir of the Meadville DEP's Bureau of Oil and Gas Management visited the upper Jones Run sites (PL 566 sites 25 and 26) and thinks that they are abandoned wells. A Growing Greener Grant proposal was submitted last week to plug five wells in the area. Rich Beam reported that BAMR is very interested in doing a project on the southern tributary of Jones Run. They are awaiting the results of the Shofestall/Zerby site to see if regrading and alkaline addition works well there since that is what they would propose to do on Jones Run. BAMR is considering beginning development of the project in the summer of 2003 if the Shofestall/Zerby site is as successful as it is expected to be."

Additionally, Growing Greener Grant applications for oil/gas well plugging were received in this office February 27, 2002. These grant applications will be review by Oil and Gas Management.

In order to promote continuing remediation efforts, funding of proposed projects from the Mill Creek Coalition should be approved.

"In March 1999 the United States Department of Agriculture (USDA) and the Natural Resources Conservation Service (NRCS), with the cooperative sponsorship by the Clarion County Commissioners, Jefferson County Commissioners, Clarion Conservation District, Jefferson Conservation District, the Headwaters Resource Conservation and Development, and the Mill Creek Coalition, submitted the "Mill Creek Watershed Plan and Environmental Assessment."

This plan recommended the construction of 58 passive mine water treatment systems in the Mill Creek watershed at a cost of $7,277,000. The plan indicated that the sponsors would incur about 52 percent of the total project cost. The report projects the plan will improve water quality and will either restore or enhance the aquatic habitat of 32.8 miles of the Mill Creek watershed."

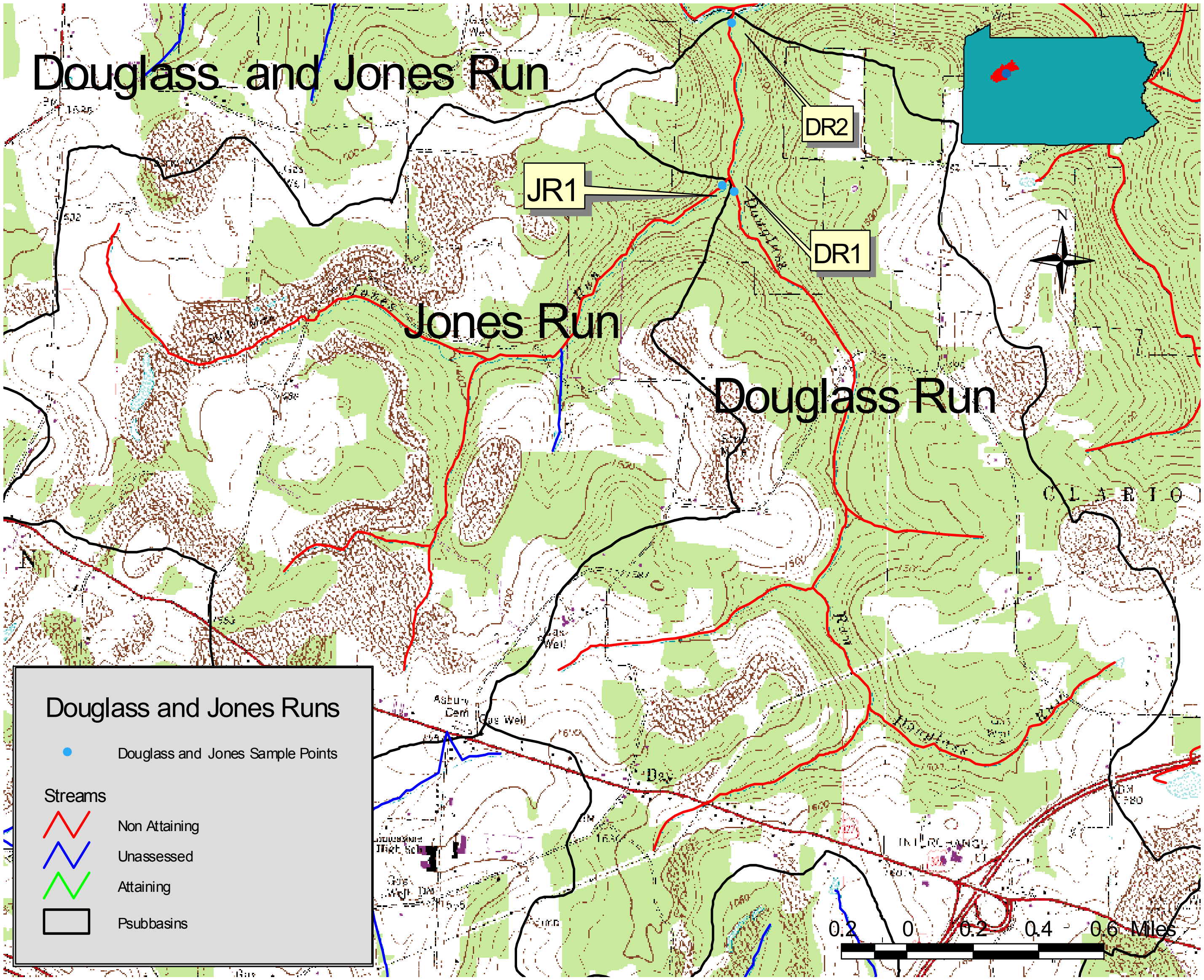
If additional mining is pursued within Douglass and/or Jones Run watersheds, the mining company will be required to meet the percent reductions noted in Attachment D for discharges from the mine site.

Public Participation

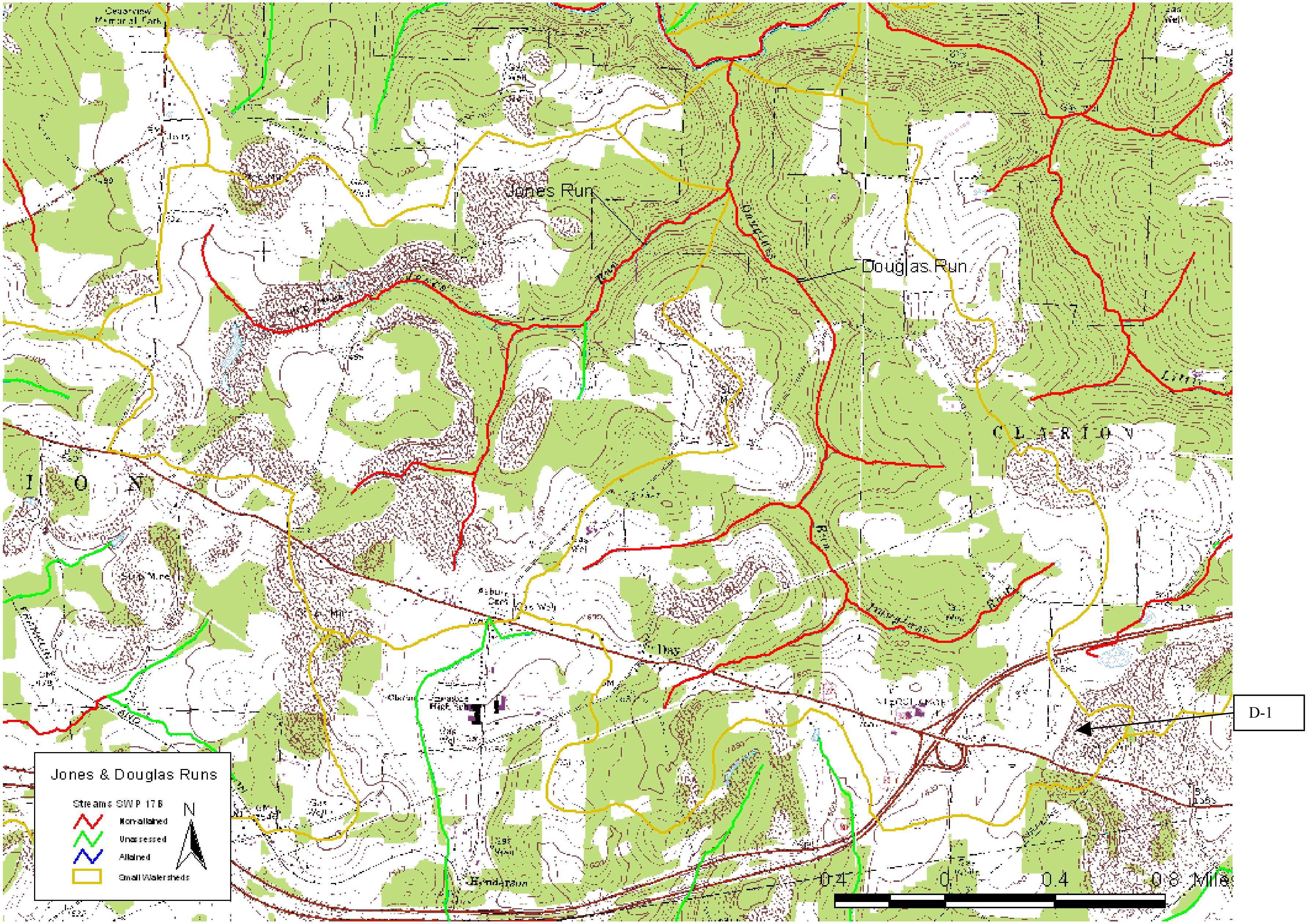
Notice of the draft TMDLs was published in the *PA Bulletin,* on September 21, 2002, and local newspaper, The Clarion News, with a 60 day comment period provided. A public meeting with watershed residents was held Wednesday, August 14, 2002 at 8 pm at the Holiday Inn, Exit 62 off I-80 in Clarion to discuss the TMDLs. Notice of final TMDL approval will be posted on the Department website.

Attachment A

Douglass and Jones Run Watershed Map



Douglass and Jones Run
DR2
JR1
DR1
Jones Run
Douglass Run
Douglass and Jones Runs
Douglass and Jones Sample Points
Streams
Non Attaining
Unassessed
Attaining
Psubbasins
0.2 0 0.2 0.4 0.6 Miles



Jones Run
Douglas Run
D-1
C L A R I O N
I O N
Jones & Douglas Runs
Streams SWP 17B
Non-attained
Unassessed
Attained
Small Watersheds
N
0.4
0
0.4
0.8 Miles

Attachment B

AMD Methodology, The pH Method and Surface Mining Control and Reclamation Act

AMD Methodology

Two approaches are used for the TMDL analysis of AMD-affected stream segments. Both of these approaches use the same statistical method for determining the instream allowable loading rate at the point of interest. The difference between the two is based on whether the pollution sources are defined as discharges that are permitted or have a responsible party, which are considered point sources. Nonpoint sources are then any pollution sources that are not point sources.

For situations where all of the impact is due to nonpoint sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are only point-source impacts or a combination of point and nonpoint sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

TMDLs and load allocations for each pollutant were determined using Monte Carlo simulation. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine any required percent reduction so that the water quality criteria will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = maximum {0, (1-Cc/Cd)} where (1)

PR = required percent reduction for the current iteration
Cc = criterion in mg/l
Cd = randomly generated pollutant source concentration in mg/l based on the observed data

Cd = RiskLognorm (Mean, Standard Deviation) where (1a)

Mean = average observed concentration
Standard Deviation = standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * (1 – PR99) where (2)

[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

LTA = allowable LTA source concentration in mg/l

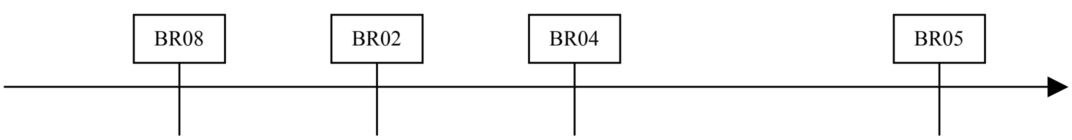
Once the required percent reduction for each pollutant source was determined, a second series of Monte Carlo simulations were performed to determine if the cumulative loads from multiple sources allow instream water quality criteria to be met at all points at least 99 percent of the time. The second series of simulations combined the flows and loads from individual sources in a step-wise fashion, so that the level of attainment could be determined immediately downstream of each source. Where available data allowed, pollutant-source flows used were the average flows. Where data were insufficient to determine a source flow frequency distribution, the average flow derived from linear regression was used.

In general, these cumulative impact evaluations indicate that, if the percent reductions determined during the first step of the analysis are achieved, water quality criteria will be achieved at all upstream points, and no further reduction in source loadings is required.

Where a stream segment is listed on the 303(d) list for pH impairment, the evaluation is the same as that discussed above; the pH method is fully explained in Attachment B. An example calculation from the Swatara Creek TMDL, including detailed tabular summaries of the Monte Carlo results, is presented for the Lorberry Creek TMDL in Attachment C. Information for the TMDL analysis performed using the methodology described above is contained in the TMDLs by segment section of this report in Attachment D.

Accounting for Upstream Reductions in AMD TMDLs

In AMD TMDLs, sample points are evaluated in headwaters (most upstream) to stream mouth (most downstream) order. As the TMDL evaluation moves downstream the impact of the previous, upstream, evaluations must be considered. The following examples are from the Beaver Run AMD TMDL (2003):



In the first example BR08 is the most upstream sample point and BR02 is the next downstream sample point. The sample data, for both sample points, are evaluated using @Risk (explained above) to calculate the existing loads, allowable loads, and a percentage reduction for aluminum, iron, manganese, and acidity (when flow and parameter data are available).

Any calculated load reductions for the upstream sample point, BR08, must be accounted for in the calculated reductions at sample point BR02. To do this (see table

Table A	Alum.	Iron	Mang.	Acidity
BR08	(#/day)	(#/day)	(#/day)	(#/day)
existing load=	3.8	2.9	3.5	0.0
allowable load=	3.8	2.9	3.5	0.0
Total Load Reduction=	**0.0**	**0.0**	**0.0**	**0.0**

A) the allowable load is subtracted from the existing load, for each parameter, to determine the total load reduction.

In table B the Total Load Reduction BR08 is subtracted from the Existing loads at BR02 to determine the Remaining Load. The Remaining Load at BR02 has the previously calculated Allowable Loads at BR02 subtracted to determine any load reductions at sample point BR02. This results in load reductions for aluminum, iron and manganese at sample point BR02.

Table B. Necessary Reductions at Beaver Run BR02

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR02	13.25	38.44	21.98	6.48
Total Load Reduction BR08	0.00	0.00	0.00	0.00
Remaining Load (Existing Load at BR02 - BR08)	13.25	38.44	21.98	6.48
Allowable Loads at BR02	2.91	9.23	7.03	6.48
Percent Reduction	78.0%	76.0%	68.0%	NA
Additional Removal Required at BR02	10.33	29.21	14.95	0.00

At sample point BR05 this same procedure is also used to account for calculated reductions at sample points BR08 and BR02. As can be seen in Tables C and D this procedure results in additional load reductions for iron, manganese and acidity at sample point BR04.

At sample point BR05 (the most downstream) no additional load reductions are required, see Tables E and F.

Table C	Alum.	Iron	Mang.	Acidity
BR08 & BR02	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	**10.33**	**29.21**	**14.95**	**0.0**

Table E	Alum.	Iron	Mang.	Acidity
BR08 BR02 &BR04	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	10.3	29.2	14.9	0.0

Table D. Necessary Reductions at Beaver Run BR04

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR04	12.48	138.80	54.47	38.76
Total Load Reduction BR08 & BR02	10.33	29.21	14.95	0.00
Remaining Load (Existing Load at BBR04 - TLR Sum	2.15	109.59	39.53	38.76
Allowable Loads at BR04	8.99	19.43	19.06	38.46
Percent Reduction	NA	82.3%	51.8%	0.8%
Additional Removal Required at BR04	0.00	90.16	20.46	0.29

Table F. Necessary Reductions at Beaver Run BR05

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR05	0.0	31.9	22.9	4.1
Total Load Reduction BR08, BR02 & BR04	10.3	119.4	35.4	0.3
Remaining Load (Existing Load at BBR05 - TLR Sum	NA	NA	NA	3.8
Allowable Loads at BR05	0.0	20.4	15.1	4.1
Percent Reduction	NA	NA	NA	NA
Additional Removal Required at BR05	0.0	0.0	0.0	0.0

Although the evaluation at sample point BR05 results in no additional removal this does not mean there are no AMD problems in the stream segment BR05 to BR04. The existing and allowable loads for BR05 show that iron and manganese exceed criteria and, any abandoned mine discharges in this stream segment will be addressed.

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Pa. Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the USEPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

There are several documented cases of streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the Section 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches added to the acidity of the polluted portion in question. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion (added to the acidity of the polluted portion) of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to reduce the acid load so the net alkalinity is greater than zero 99% of time.

Reference: *Rose, Arthur W. and Charles A. Cravotta, III 1998. Geochemistry of Coal Mine Drainage. Chapter 1 in Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania. Pa. Dept. of Environmental Protection, Harrisburg, Pa.*

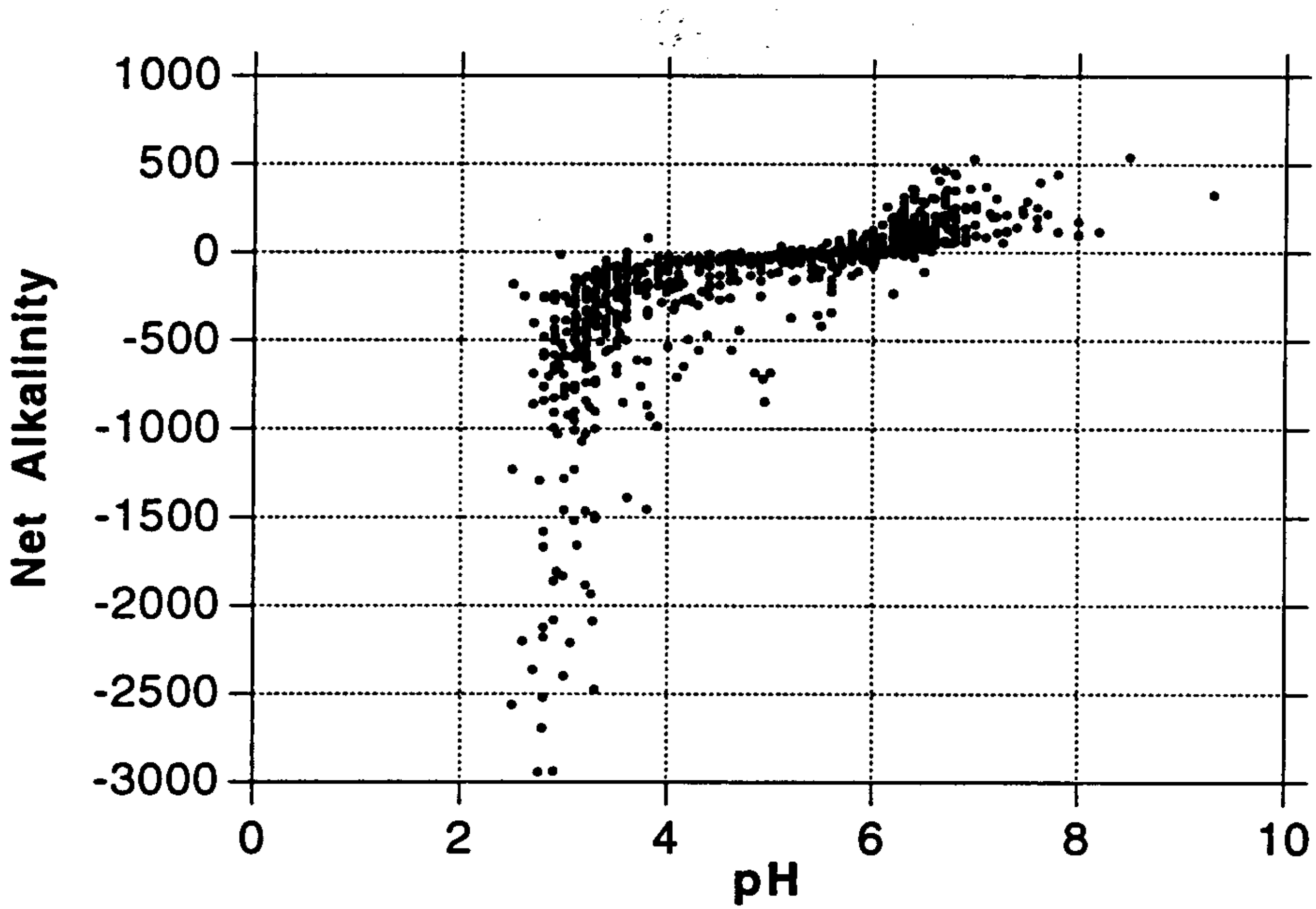


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Surface Mining Control and Reclamation Act

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to established a nationwide program to, among other things, protect the beneficial uses of land or water resources, and pubic health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called "pre-law" mines) are not subject to the requirements of SMCRA.

Title IV of the Act is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations shall be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the affected land to a condition capable of supporting the uses which it was capable of supporting prior to any mining,

- Backfilling and compacting (to insure stability or to prevent leaching of toxic materials) in order to restore the approximate original contour of the land with all highwalls being eliminated, and topsoil replaced to allow revegetation, and

- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

For purposes of these TMDLs, point sources are identified as NPDES-permitted discharge points, and nonpoint sources include discharges from abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. In the absence of an NPDES permit, the discharges associated with these land uses were assigned load allocations.

The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Related Definitions

Pre-Act (Pre-Law) - Mines that ceased operating by the effective date of SMCRA and are not subject to the requirements of SMCRA.

Bond – A instrument by which a permittee assures faithful performance of the requirements of the acts, this chapter, Chapters 87-90 and the requirements of the permit and reclamation plan.

Postmining pollution discharge – A discharge of mine drainage emanating from or hydrologically connected to the permit area, which may remain after coal mining activities have been completed, and which does not comply with the applicable effluent requirements described in Chapters 87.102, 88.92, 88.187, 88.292, 89.52 or 90.102. The term includes minimal-impact postmining discharges, as defined in Section of the Surface Mining Conservation and Reclamation Act.

Forfeited Bond – Bond money collected by the regulatory authority to complete the reclamation of a mine site when a permittee defaults on his reclamation requirements.

Attachment C

Example Calculation: Lorberry Creek

Lorberry Creek was evaluated for impairment due to high metals contents in the following manner: the analysis was completed in a stepwise manner, starting at the headwaters of the stream and moving to the mouth. The Rowe Tunnel (Swat-04) was treated as the headwaters of Lorberry Creek for the purpose of this analysis.

1. A simulation of the concentration data at point Swat-04 was completed. This estimated the necessary reduction needed for each metal to meet water quality criteria 99 percent of the time as a long-term average daily concentration. Appropriate concentration reductions were made for each metal.

2. A simulation of the concentration data at point Swat-11 was completed. It was determined that no reductions in metals concentrations are needed for Stumps Run at this time. Therefore, no TMDL for metals in Stumps Run is required at this time.

3. A mass balance of loading from Swat-04 and Swat-11 was completed to determine if there was any need for additional reductions as a result of combining the loads. No additional reductions were necessary.

4. The mass balance was expanded to include the Shadle Discharge (L-1). It was estimated that best available technology (BAT) requirements for the Shadle Discharge were adequate for iron and manganese. There is no BAT requirement for aluminum. A wasteload allocation was necessary for aluminum at point L-1.

There are no other known sources below the Shadle Discharge. However, there is additional flow from overland runoff and one unnamed tributary not impacted by mining. It is reasonable to assume that the additional flow provides assimilation capacity below point L-1, and no further analysis is needed downstream.

The calculations are detailed in the following section (Tables 1-8). Table 9 shows the allocations made on Lorberry Creek.

1. A series of four equations was used to determine if a reduction was needed at point Swat-04, and, if so the magnitude of the reduction.

Table 1. Equations Used for Rowe Tunnel Analysis (SWAT 04)

	Field Description	Equation	Explanation
1	Swat-04 Initial Concentration Value (Equation 1A)	= Risklognorm (Mean, St Dev)	This simulates the existing concentration of the sampled data.
2	Swat-04 % Reduction (from the 99th percentile of percent reduction)	= (Input a percentage based on reduction target)	This is the percent reduction for the discharge.
3	Swat-04 Final Concentration Value	= Sampled Value x (1-percent reduction)	This applies the given percent reduction to the initial concentration.
4	Swat-04 Reduction Target (PR)	= Maximum (0, 1- Cd/Cc)	This computes the necessary reduction, if needed, each time a value is sampled. The final reduction target is the 99th percentile value of this computed field.

2. The reduction target (PR) was computed taking the 99th percentile value of 5,000 iterations of the equation in row four of Table 1. The targeted percent reduction is shown, in boldface type, in the following table.

Table 2. Swat-04 Estimated Target Reductions			
Name	Swat-04 Aluminum	Swat-04 Iron	Swat-04 Manganese
Minimum =	0	0.4836	0
Maximum =	0.8675	0.9334	0.8762
Mean =	0.2184	0.8101	0.4750
Std. Deviation =	0.2204	0.0544	0.1719
Variance =	0.0486	0.0030	0.0296
Skewness =	0.5845	-0.8768	-0.7027
Kurtosis =	2.0895	4.3513	3.1715
Errors Calculated =	0	0	0
Targeted Reduction % =	**72.2**	**90.5**	**77.0**
Target #1 (Perc%)=	99	99	99

3. This PR value was used as the percent reduction in the equation in row three of Table 1. Testing was done to see that the water quality criterion for each metal was achieved at least 99 percent of the time. This verified the estimated percent reduction necessary for each metal. Table 3 shows, in boldface type, the percent of the time criteria for each metal was achieved during 5,000 iterations of the equation in row three of Table 1.

Table 3. Swat-04 Verification of Target Reductions			
Name	Swat-04 Aluminum	Swat-04 Iron	Swat-04 Manganese
Minimum =	0.0444	0.2614	0.1394
Maximum =	1.5282	2.0277	1.8575
Mean =	0.2729	0.7693	0.4871
Std Deviation =	0.1358	0.2204	0.1670
Variance =	0.0185	0.0486	0.0279
Skewness =	1.6229	0.8742	1.0996
Kurtosis =	8.0010	4.3255	5.4404
Errors Calculated =	0	0	0
Target #1 (value) (WQ Criteria)=	0.75	1.5	1
Target #1 (Perc%)=	**99.15**	**99.41**	**99.02**

4. These same four equations were applied to point Swat-11. The result was that no reduction was needed for any of the metals. Tables 4 and 5 show the reduction targets computed for, and the verification of, reduction targets for Swat-11.

Table 4. Swat-11 Estimated Target Reductions			
Name	Swat-11 Aluminum	Swat-11 Iron	Swat-11 Manganese
Minimum =	0.0000	0.0000	0.0000
Maximum =	0.6114	0.6426	0.0000
Mean =	0.0009	0.0009	0.0000
Std Deviation =	0.0183	0.0186	0.0000
Variance =	0.0003	0.0003	0.0000
Skewness =	24.0191	23.9120	0.0000
Kurtosis =	643.4102	641.0572	0.0000
Errors Calculated =	0	0	0
Targeted Reduction % =	**0**	**0**	**0**
Target #1 (Perc%) =	99	99	99

Table 5. Swat-11 Verification of Target Reductions			
Name	Swat-11 Aluminum	Swat-11 Iron	Swat-11 Manganese
Minimum =	0.0013	0.0031	0.0246
Maximum =	1.9302	4.1971	0.3234
Mean =	0.0842	0.1802	0.0941
Std Deviation =	0.1104	0.2268	0.0330
Variance =	0.0122	0.0514	0.0011
Skewness =	5.0496	4.9424	1.0893
Kurtosis =	48.9148	48.8124	5.1358
Errors Calculated =	0	0	0
WQ Criteria =	**0.75**	**1.5**	**1**
% of Time Criteria Achieved =	**99.63**	**99.60**	**100**

5. Table 6 shows variables used to express mass balance computations.

Table 6. Variable Descriptions for Lorberry Creek Calculations	
Description	**Variable Shown**
Flow from Swat-04	Q_{swat04}
Swat-04 Final Concentration	C_{swat04}
Flow from Swat-11	Q_{swat11}
Swat-11 Final Concentration	C_{swat11}
Concentration below Stumps Run	C_{stumps}
Flow from L-1 (Shadle Discharge)	Q_{L1}
Final Concentration From L-1	C_{L1}
Concentration below L-1	C_{allow}

6. Swat-04 and Swat-11 were mass balanced in the following manner:

The majority of the sampling done at point Swat-11 was done in conjunction with point Swat-04 (20 matching sampling days). This allowed for the establishment of a significant correlation between the two flows (the R-squared value was 0.85). Swat-

04 was used as the base flow, and a regression analysis on point Swat-11 provided an equation for use as the flow from Swat-11.

The flow from Swat-04 (Q_{swat04}) was set into an @RISK function so it could be used to simulate loading into the stream. The cumulative probability function was used for this random flow selection. The flow at Swat-04 is as follows (Equation 1):

$$Q_{swat04} = \text{RiskCumul(min,max,bin range, cumulative percent of occurrence)} \quad (1)$$

The RiskCumul function takes four arguments: minimum value, maximum value, the bin range from the histogram, and cumulative percent of occurrence.

The flow at Swat-11 was randomized using the equation developed through the regression analysis with point Swat-04 (Equation 2).

$$Q_{swat11} = Q_{swat}04 \times 0.142 + 0.088 \quad (2)$$

The mass balance equation is as follows (Equation 3):

$$C_{stumps} = ((Q_{swat04} * C_{swat04}) + (Q_{swat11} * C_{swat11}))/(Q_{swat04}+Q_{swat11}) \quad (3)$$

This equation was simulated through 5,000 iterations, and the 99th percentile value of the data set was compared to the water quality criteria to determine if standards had been met. The results show there is no further reduction needed for any of the metals at either point. The simulation results are shown in Table 7.

Table 7. Verification of Meeting Water Quality Standards Below Stumps Run

Name	Below Stumps Run Aluminum	Below Stumps Run Iron	Below Stumps Run Manganese
Minimum =	0.0457	0.2181	0.1362
Maximum =	1.2918	1.7553	1.2751
Mean =	0.2505	0.6995	0.4404
Std Deviation =	0.1206	0.1970	0.1470
Variance =	0.0145	0.0388	0.0216
Skewness =	1.6043	0.8681	1.0371
Kurtosis =	7.7226	4.2879	4.8121
Errors Calculated =	0	0	0
WQ Criteria =	**0.75**	**1.5**	**1**
% of Time Criteria Achieved =	**99.52**	**99.80**	**99.64**

7. The mass balance was expanded to determine if any reductions would be necessary at point L-1.

The Shadle Discharge originated in 1997, and very few data are available for it. The discharge will have to be treated or eliminated. It is the current site of a USGS test remediation project. The data that were available for the discharge were collected at a point prior to a settling pond. Currently, no data for effluent from the settling pond are available.

Modeling for iron and manganese started with the BAT-required concentration value. The current effluent variability based on limited sampling was kept at its present level. There was no BAT value for aluminum, so the starting concentration for the modeling was arbitrary. The BAT values for iron and manganese are 6 mg/l and 4 mg/l, respectively. Table 8 shows the BAT-adjusted values used for point L-1.

Table 8. L-1 Adjusted BAT Concentrations

Parameter	Measured Value		BAT adjusted Value	
	Average Conc.	*Standard Deviation*	*Average Conc.*	*Standard Deviation*
Iron	538.00	19.08	6.00	0.21
Manganese	33.93	2.14	4.00	0.25

The average flow (0.048 cfs) from the discharge will be used for modeling purposes. There were not any means to establish a correlation with point Swat-04.

The same set of four equations used for point Swat-04 was used for point L-1. The equation used for evaluation of point L-1 is as follows (Equation 4):

$$C_{allow} = ((Q_{swat04}*C_{swat04})+(Q_{swat11}*C_{swat11})+(Q_{L1}*C_{L1}))/(Q_{swat04}+Q_{swat11}+Q_{L1}) \quad (4)$$

This equation was simulated through 5,000 iterations, and the 99th percentile value of the data set was compared to the water quality criteria to determine if standards had been met. It was estimated that an 81 percent reduction in aluminum concentration was needed for point L-1.

8. Table 9 shows the simulation results of the equation above.

Table 9. Verification of Meeting Water Quality Standards Below Point L-1			
Name	**Below L-1 Aluminum**	**Below L-1 Iron**	**Below L-1 Manganese**
Minimum =	0.0815	0.2711	0.1520
Maximum =	1.3189	2.2305	1.3689
Mean =	0.3369	0.7715	0.4888
Std Deviation =	0.1320	0.1978	0.1474
Variance =	0.0174	0.0391	0.0217
Skewness =	1.2259	0.8430	0.9635
Kurtosis =	5.8475	4.6019	4.7039
Errors Calculated =	0	0	0
WQ Criteria=	**0.75**	**1.5**	**1**
Percent of time achieved=	**99.02**	**99.68**	**99.48**

9. Table 10 presents the estimated reductions needed to meet water quality standards at all points in Lorberry Creek.

Table 10. Lorberry Creek Summary						
		Measured Sample Data		**Allowable**		**Reduction Identified**
Station	Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)	%
Swat 04						
	Al	1.01	21.45	0.27	5.79	73%
	Fe	8.55	181.45	0.77	16.33	91%
	Mn	2.12	44.95	0.49	10.34	77%
Swat 11						
	Al	0.08	0.24	0.08	0.24	0%
	Fe	0.18	0.51	0.18	0.51	00%
	Mn	0.09	0.27	0.09	0.27	00%
L-1						
	Al	34.90	9.03	6.63	1.71	81%
	Fe	6.00	1.55	6.00	1.55	0%
	Mn	4.00	1.03	4.00	1.03	0%

All values shown in this table are long-term average daily values

The TMDL for Lorberry Creek requires that a load allocation be made to the Rowe Tunnel Discharge (Swat-04) for the three metals listed, and that a wasteload allocation is made to the Shadle Discharge (L-1) for aluminum. There is no TMDL for metals required for Stumps Run (Swat-11) at this time.

Margin of Safety

For this study, the margin of safety is applied implicitly. The allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. Other margins of safety used for this TMDL analysis include the following:

- None of the data sets were filtered by taking out extreme measurements. Because the 99 percent level of protection is designed to protect for the extreme event, it was pertinent not to filter the data set.

- Effluent variability plays a major role in determining the average value that will meet water quality criteria over the long term. This analysis maintained that the variability at each point would remain the same. The general assumption can be made that a treated discharge would be less variable than an untreated discharge. This implicitly builds in another margin of safety.

Attachment D

TMDLs By Segment

Douglass and Jones Run

The TMDLs for Douglass and Jones Run consists of load allocations of three sampling sites along the streams. Following is an explanation of the TMDL for each allocation point.

Douglass Run was put on the 303(d) list for high metals. Jones Run is listed for both high metals and low pH from AMD as being the cause of the degradation to the stream. The method and rationale for addressing pH is contained in Attachment B.

<u>TMDL calculations- Point DR 1 Douglas Run at the confluence with Jones Run</u>

The TMDL for sample point DR1 consists of a load allocation to all of the area above the point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point DR1. The average flow, measured at the sampling point DR1 (6.21 MGD), is used for these computations.

There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point DR1 shows pH ranging between 3.2 and 4.4. For this reason pH will be addressed as part of this TMDL. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see *TMDL Endpoint* section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at point DR1 for aluminum, iron, manganese and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. The following table shows the load allocations for this stream segment.

Table D1. Load Allocations at Point DR1					
	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA conc. (mg/l)	Load (lbs/day)	%
Al	1.41	73.2	0.11	5.9	92%
Fe	5.53	286.5	0.44	22.9	92%
Mn	2.83	146.7	0.14	7.3	95%
Acidity	89.79	4650.5	0.00	0.0	100%
Alkalinity	0.67	34.5			

The allowable loading values shown in Table D1 represent load allocations made at point DR1.

TMDL calculations- Point JR1 Downstream on Jones Run at the confluence with Douglas Run

The TMDL for sample point JR1 consists of a load allocation to all of the area above the point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point JR1. The average flow, measured at the sampling point JR1 (3.40 MGD), is used for these computations.

There currently is an entry for this segment on the Pa 303(d) list for impairment due to pH. For this reason pH will be addressed as part of this TMDL. Sample data at point JR1 shows pH ranging between 2.5 and 4. The objective is to reduce acid loading to the stream, which will in turn raise the pH and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see *TMDL Endpoint* section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at point JR1 for aluminum, iron, manganese and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. The following table shows the load allocations for this stream segment.

	Table D2. Load Allocations at Point JR1				
	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA conc. (mg/l)	Load (lbs/day)	%
Al	0.64	18.2	0.06	1.8	90
Fe	40.79	1155.0	0.41	11.6	99
Mn	18.18	514.7	0.36	10.3	98
Acidity	234.33	6635.7	0.00	0.0	100
Alkalinity	0.98	27.6			

The allowable loading values shown in Table D2 represent load allocations made at point JR1.

<u>TMDL Calculation – Sampling Point DR2 Douglass Run at the mouth of the stream at the confluence with Mill Creek</u>

The TMDL for sampling point DR2 on Douglass Run consists of a load allocation from sample point DR2 to sample points DR1 and JR1 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point DR2. The average flow at sample points JR1 (2357.98) and DR1 (4312.8) were added together to give a measure of DR2's flow (6670.78). The flow for DR2 is calculated as 9.61 MGD. This value is used because the observed flow of DR2 was not consistent with flows recorded at the other sample points in this watershed.

There currently is not an entry for this segment on the Pa 303(d) list for impairment due to pH. Sample data at point DR2 shows pH ranging between 2.9 and 3.8; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see *TMDL Endpoint* section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

The existing and allowable loading for point DR2 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any load reductions already specified from upstream sources. The load reduction from point DR1 and JR1 was summed and then subtracted from the existing load at point DR2. This was compared to the allowable load at DR2 for each parameter to determine if any further reductions were needed at this point.

An allowable long-term average in-stream concentration was determined at point DR2 for aluminum, iron, and manganese. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was log normally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. Table D3 shows the load allocations for this stream segment.

Table D3. Load Allocations at Point DR2

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	6.78	542.8	0.54	43.4
Fe	20.27	1624.0	0.41	32.5
Mn	16.55	1325.9	0.66	53.0
Acidity	160.89	12889.1	0.00	0.0
Alkalinity	0.00	0.0		

The loading reductions for points DR1 and JR1 were summed to show the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point DR2. This value was then compared to the allowable load at point DR2. Reductions at point DR2 are necessary for any parameter that exceeded the allowable load at this point. Table D4 shows a summary of all loads that affect point DR2. Table D5 illustrates the necessary reductions at point DR2.

Table D4. Summary of All Loads that Affect Point DR2

	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Sample Point DR1				
load reduction=	67.3	263.6	139.4	4650.5
Sample Point JR1				
load reduction=	16.4	1143.4	504.4	6635.7

Table D5. Necessary Reductions at Sample Point DR2				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Existing Loads at DR2	542.8	1624.0	1325.9	12889.1
Total Load Reduction (Sum of DR1 and JR1)	83.7	1407.0	643.8	11286.2
Remaining Load (Existing Loads at DR2-TLR Sum)	459.1	217.0	682.1	1602.9
Allowable Loads at DR2	43.4	32.5	53.0	0.0
Percent Reduction	91	85	92	100
Additional Removal Required at DR2	415.7	184.5	629.1	1602.9

The calculated flow, measured at sample point DR2, is used for these computations. The TMDL for DR2 consists of load allocations for aluminum, iron, Manganese and acidity to all of the area upstream of DR2 shown in Attachment A. The percent reduction was calculated using below equation.

$$\left[1-\left(\frac{\text{Allowable Loads at DR2}}{\text{Remaining Load (Existing Loads at DR2 - TLR Sum}}\right)\right]\times 100\,\%$$

Margin of Safety

PADEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water Quality standard states that water quality criteria must be met at least 99% of the time. All of the @Risk analyses results surpass the minimum 99% level of protection. Another margin of safety used for this TMDL analysis results from:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- A MOS is also the fact that the calculations were done with a daily Fe average instead of the 30-day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in these TMDLs because the data used represents all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

Attachment E

Excerpts Justifying Changes Between the 1996, 1998, Draft 2000, and Draft 2002 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, draft 2000, and Draft 2002 list. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 Section 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 Section 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 Section 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

The most notable difference between the 1998 and Draft 2000 Section 303(d) lists are the listing of unnamed tributaries in 2000. In 1998, the GIS stream layer was coded to the named stream level so there was no way to identify the unnamed tributary records. As a result, the unnamed tributaries were listed as part of the first downstream named stream. The GIS stream coverage used to generate the 2000 list had the unnamed tributaries coded with the DEP's five-digit stream code. As a result, the unnamed tributary records are now split out as separate records on the 2000 Section 303(d) list. This is the reason for the change in the appearance of the list and the noticeable increase in the number of pages. After due consideration of comments from EPA and PADEP on the Draft 2000 Section 303(d) list, the Draft 2002 Pa Section 303(d) list was written in a manner similar to the 1998 Section 303(d) list.

Attachment F

Water Quality Data Used In TMDL Calculations

Point	DATE	FLOW	pH	Acidity	Alkalinity	TSS	Al	Fe	Mn	SO4
DR1		gpm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	4/15/1975	4064	3.4	82	0			4.9		375
	5/6/1975	5567	3.8	40	0			2.3		300
	6/9/1975	3826	3.7	38	0			3		300
	7/17/1975	1439	3.2	130	0			7.8		330
	8/19/1975	771	3.5	200	0			14		286
	9/17/1975	1886	3.8	92	0			12		24
	10/14/1975	1938	4.3	176	2			6.5		375
	11/11/1975	1975	3.7	80	0			6		270
	12/9/1975	3145	3.7	72	0			4.2		137
	1/20/1976	4319	3.6	104	0			4.4		225
	2/17/1976	23400	4.4	18	8			2.2		125
	3/24/1976	5676	3.8	82	0			3.2		175
	4/27/1976	6186	4	70	0			3.8		165
	9/19/2001	100	3.4	100.8	0	8	0.025	0.15	0.025	173
	11/1/2001	400	3.8	62	0	1.5	2.8	8.52	5.64	210
	Mean	4312.80	3.74	89.79	0.67	4.75	1.41	5.53	2.83	231.33
	St Dev	5630.14	0.320268	48.945	2.093072	4.596194	1.962221	3.756786	3.970405	99.85466

Point	DATE	FLOW	pH	Acidity	Alkalinity	TSS	Al	Fe	Mn	SO4
JR1		gpm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	4/15/1975	2654	3	400	0			27		825
	5/16/1975	3426	3.1	140	0			17		375
	6/9/1975	3997	3.2	158	0			18		650
	7/17/1975	1332	3	260	0			27		638
	8/19/1975	597	3.2	440	0			50		660
	9/17/1975	1305	3.2	232	0			49		710
	10/13/1975	1522	3.2	264	0			47		750
	11/11/1975	1409	3.4	252	0			32		1100
	12/9/1975	2221	3.3	188	0			38		490
	1/20/1976	4798	3.5	204	0			29		713
	2/17/1976	26019	4	140	0			7.9		290
	3/24/1976	2404	3.5	186	0			25		625
	4/27/1976	3339	3.4	204	0			25		475
	4/001979	1500	3.4	159	1	1	0	26.5	14.6	500
	1/6/1981	600	2.8	306	1	6.8	0	50	30	800
	4/1/1981	1500	3.5	240	0	4	0	44	25	460

	7/6/1981	600	3.1	327	1	16.3	0	82.5	13.2	770
	10/5/1981	600	2.9	336	1	6.1	0	85	27	900
	1/7/1982	2500	3.3	138	1	4.2	0	22.6	10.5	315
	4/6/1982	3000	3.2	218	1	6.3	0	42	18	640
	1/4/1983	600	2.9	242	20	18	0	50.4	17.6	490
	4/5/1983	1000	3.4	163	1	4.6	0	25.5	11.82	450
	7/6/1983	1000	3.1	204	1	4.8	0	29.91	16.8	555
	10/3/1983	400	3.1	385	1	12.1	0	99.99	36	970
	1/3/1984	800	3.3	210	1	0.05	0	43.9	16.9	530
	4/3/1984	1500	3.4	288	1	4.8	0	17.43	10.05	360
	7/30/1984	600	3.5	276	1	0.05	0	55.2	21.5	775
	10/29/1984	2500	3	180	0	11.6	0	20	14.4	350
	1/4/1985	2000	3.1	142	1	1	0	18.49	10.68	380
	4/10/1985	3000	3.2	189	0	2	0	25.5	13.5	551
	7/19/1985	1200	3	273	1	12.3	0	75.4	25.2	835
	10/9/1985	1500	2.5	276	1	5.5	0	68.3	24.3	850
	1/4/1985	2000	3.1	142	1	1	0	18.49	10.68	380
	4/10/1985	3000	3.2	189	0	2	0	25.5	13.5	551
	7/19/1985	1200	3	273	1	12.3	0	75.4	25.2	835
	10/9/1985	1500	2.5	276	1	5.5	0	68.3	24.3	850
	1/23/1986	1800	3.2	134	0	1.5	0	17.8	9.1	349
	4/30/1986	2500	2.9	197	1	6.7	0	52.1	12.9	426
	9/19/2001	420	3.1	306	0	6	8.87	55.3	20.8	526
	11/1/2001	476	3.2	236	0	1.5	8.53	44.1	17.2	471.1
	Mean	2357.98	3.17	234.33	0.98	5.85	0.64	40.79	18.18	604.25
	Stdev	3982.28094	0.271735	75.44955	3.125474	4.920766	2.322337	22.17681	6.966571	201.4553
Point	**DATE**	**FLOW**	**pH**	**Acidity**	**Alkalinity**	**TSS**	**Al**	**Fe**	**Mn**	**SO4**
DR2		**gpm**		**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
	4/8/1975	8209	3.1	154	0			11		450
	5/6/1975	9875	3.3	108	0			9.5		375
	6/9/1975	8000	3.3	90	0			9.5		450
	7/17/1975	1269	3	240	0			1.9		528
	8/18/1975	1178	3.2	300	0			24		506
	9/17/1975	2847	3.2	192	0			64		490
	10/13/1975	2350	3.8	40	0			30		650
	11/10/1975	5587	3.5	100	0			9.7		230
	12/8/1975	3069	3.4	144	0			16		250
	2/25/1976	7593	2.9	174	0			11		410

3/24/1976	5916	3.8	150	0			10		500
4/27/1976	6662	3.7	124	0			10		413
9/19/2001	565	3.1	254.4	0	4	7.42	44.8	19.1	462
11/1/2001	656	3.3	182	0	4	6.13	32.4	14	433
Mean	4555.42857	3.328571	160.8857	0	4	6.775	20.27143	16.55	439.0714
Stdev	3203.60479	0.284006	70.10781	0	0	0.912168	17.21352	3.606245	107.0854
	Flow used=	DR1 +JR1=flow		2357.98 +	4312.8	=6670.78			
	6670.78								

Attachment G

Comment and Response

Comment 1: Table 1, because of the large difference in length between the 1996 and 1998 listings, please note the reason for the difference.

Response: See Attachment E

Comment 2: The *Watershed History* section is somewhat confusing. It is assumed that the final TMDL Report will include the SMCRA attachment and all of the terms used in the *Watershed History* section will be defined.

Response: See Attachment B.

Comment 3: A schematic map showing the locations of each mine, D1 seep, and the oil/gas artesian wells.

Response: See Attachment A: mine locations are available on quads at the District Mining Office; they have not been converted to shape files for use with ArcView, the D-1 seep is on the map, and few of the abandoned oil or gas wells have been mapped (and those are on the quads).

Comment 4: Please confirm that both Mauersburg Coal Company's Terwilliger Mine and Glacial Minerals, Inc. were pre-Act.

Response: Yes these are pre-Act mine sites.

Comment 5: Please identify the likely pollutants from the oil/gas wells.

Response: Same as AMD: acidity, aluminum, iron, and manganese.

Comment 6: In addition, a description of current land uses would be helpful.

Response: Residential, unmanaged natural wildlife habitat, forestland, cropland/land occasionally cut for hay.

Comment 7: The parameters in Table 3 should be identified.

Response: The parameters in Table 3 are identified.